# The Localization of Lesions in the Pons and Preoblongata.

CLINICAL LECTURE DELIVERED AT THE PHILADELPHIA HOSPITAL.

By CHARLES K. MILLS, M.D.,

Professor of Mental Diseases and of Medical Jurisprudence in the University of Pennsylvania; Neurologist to the Philadelphia Hospital, etc.

[REPRINTED FROM INTERNATIONAL CLINICS, VOL. III., FIFTH SERIES.]

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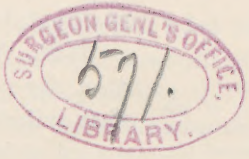

# THE LOCALIZATION OF LESIONS IN THE PONS AND PREOBLONGATA.

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GENTLEMEN,—During this and the last lecture term I have shown you a number of cases of disease of the cranial nerves and of the pons and oblongatas. Several of these cases have died, and you have seen how closely the focal diagnosis of a small gross lesion in a restricted and structurally complicated region can be diagnosticated. The gross specimens, microscopical sections, and drawings from one of these cases were exhibited during the last term, and to-day I show you also the specimens, with photographs and drawings, of another case. Both of these cases are illustrations of localized pontile softening, such as would be expected from destructive lesions. Both involved important longitudinal and transverse tracts and the root-fibres of certain cranial nerves. The lesions were small but deeply situated.

FIG. 1.

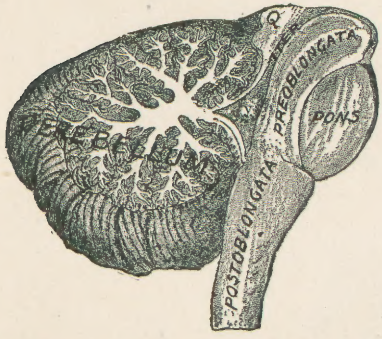


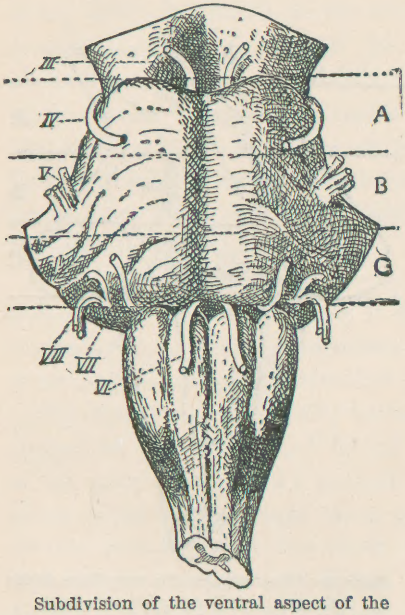

Diagram showing the relations of the pons, preoblongata, and postoblongata to the fourth ventricle, iter, gemina, and cerebellum: *Q*, quadrigeminal body; *V*, fourth ventricle.

With Wilder, I prefer to restrict the term pons to the somewhat cylindrical body occupying a ventral or inferior position in the cerebro-spinal axis between the crura and the postoblongata,—usually termed the medulla oblongata,—applying the term preoblongata to the important strip of nerve-substance between the pons proper and the fourth ventricle, its dorsal surface being the floor of the ventricle. The nuclei of the cranial

nerves, from the fourth to the twelfth, are situated in the oblongatas. The pons proper is largely made up of fibre tracts, but it contains also a few special nuclei. In Fig. 1 are shown the relations of the oblongatas to each other, to the pons, and to the fourth ventricle.

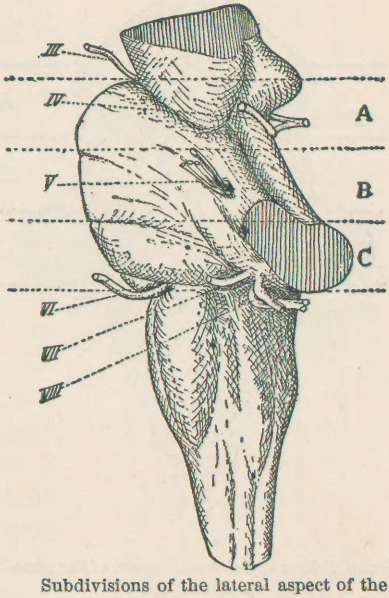
For the purposes both of focal diagnosis and description it is well to have some readily applied topographical scheme. The common method of dividing parts into thirds is convenient and useful. The Rolandic or motor region of the cortex, for instance, is frequently referred to with relation to the upper, middle, or lower thirds of the

FIG. 2.




Subdivision of the ventral aspect of the pons into thirds, showing the relations of important structures to each subdivision.

FIG. 3.




Subdivisions of the lateral aspect of the pons and preoblongata. The nerves are indicated by the Roman numerals.

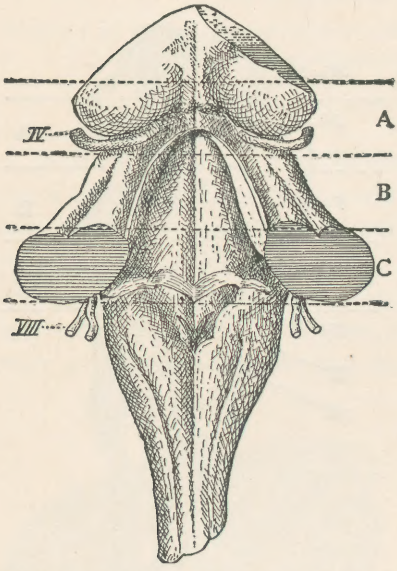
central fissure, and convolutions and lobes are often divided into thirds in describing the positions and extensions of lesions. By dividing the combined pons and preoblongata into thirds in two directions, we are able to focus our attention upon any one of nine segments. The diagnostician must know the gross anatomy of this region, and to some extent he should be familiar with its nuclei and fibre systems, as shown in microscopical sections.

I have here ventral, lateral, and dorsal views of the gross appearances presented by the pons and preoblongata (Figs. 2, 3, and 4), represented as divided into thirds by horizontal dotted lines. The lines

shown on the different surfaces correspond as determined by sections of actual specimens, the planes of the sections being at right angles with the cerebro-spinal axis.

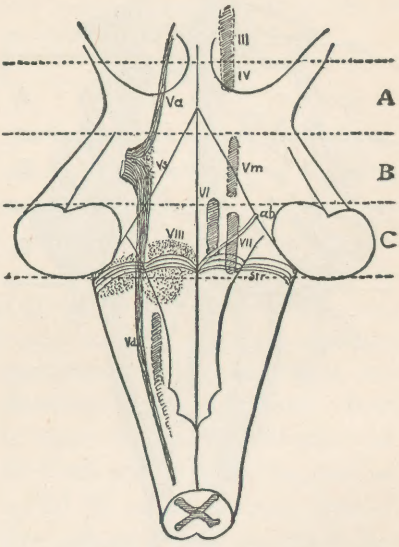
The cephalic and middle thirds of the ventral portion of the pons (Fig. 2) contain chiefly transverse and longitudinal fibre tracts; what these are will presently be learned. The third nerves are seen emerging between the cephalic third and the crus, and at the junction of the pons and the postoblongata are the abducens, and more laterally the facial and auditory nerves. On the lateral aspect of the cephalic

FIG. 4.




Subdivisions of the dorsal aspect of the pons-preoblongata.

FIG. 5.




Position of the nerve-nuclei, root-fibres of the fifth, and medullary or acoustic striæ.

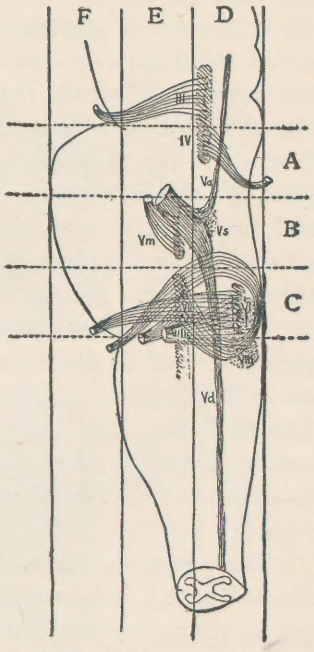
third, near the crus, the trunk of the fourth nerve appears, and the fifth nerve in the middle third, while the seventh and eighth nerves are seen in the lower third of the lateral as well as of the ventral third. In the cephalic division (*A*) of the dorsal aspect is seen the postgeminum or posterior tubercles of the quadrigeminal body, and also the fourth or pathetic nerve at its origin and in part of its course. The middle third (*B*) includes the prepeduncle, or superior cerebellar peduncle, and a portion of the floor of the fourth ventricle. Both the middle and caudal thirds are partly traversed by the medipeduncle, and the caudal third (*C*) by the acoustic or medullary striæ.

In order to progress with our diagnostic work, it is now necessary

to pass with our mental vision beneath the surfaces of the bodies we are considering. Let us first glance into or just beneath the floor of the fourth ventricle. With the aid of Fig. 5, which is largely diagrammatic,—the relations of the parts being, however, as in actual specimens,—the positions of the nuclei of the third, fifth, sixth, seventh, and eighth nerves are made evident. The nuclei of the third nerve are situated in the gray matter along the course of the Sylvian aqueduct, cephalad of subdivision *A*, and the nucleus of the fourth nerve adjoins the nuclei of the third in the upper portion of this cephalic segment, lying chiefly beneath the postgeminum. Both the sensory and motor nuclei of the fifth nerve are in the middle third, while the nuclei of the sixth and seventh and a large part of the eighth are in the caudal or lower third. Hence, when nuclear symptoms referable to any one or more of these nerves are present, the topography of the lesions causing them can be understood and readily stated with reference to these subdivisions.

The root-fibres of the nerves which spring from these nuclei have, it must be remembered, within the substance of the preoblongata and pons, courses of considerable extent and complexity before they appear on the ventral and lateral aspect of the pons. In Fig. 6 a general idea is given of the dorso-ventral routes pursued by the root-fibres of the third, fourth, fifth, sixth, seventh, and eighth nerves. In this illustration new lines are shown, drawn longitudinally and at right angles to those already used in making the subdivisions *A*, *B*, and *C;* thus giving in lateral view nine segments, the thirds *A*, *B*, and *C* each being subdivided into thirds,—three ventral, three dorsal, and three intermediate (that is, intermediate between the dorsal and the ventral segments).

FIG. 6.




A lateral diagrammatic view of the course of the root-fibres of the cranial nerves from the third to the eighth. The diagram is shown subdivided into thirds longitudinally (D, E, and F) as well as horizontally (A, B, and C).

The root-fibres as well as the nuclei of the third nerve chiefly lie cephalad of all the above subdivisions. In the cephalo-dorsal third it will be seen that the root-fibres of the fourth nerve and that branch of

the fifth formerly called descending, but now known as the ascending branch, pursue their way. In the dorsal and intermediate segments of the middle third (*B*) both descending and ascending roots of the fifth nerve are seen, as are also a few of the curving fibres of the curiously twisting roots of the seventh nerve; while in the dorsal and intermediate segments of the caudal subdivision (*C*) are crowded the root-fibres systems of the sixth, seventh, and eighth nerves.

Making now dorso-ventral sections through the middle of each of the subdivisions *A*, *B*, and *C*, the appearances of such transections, as seen under low powers of the microscope, would be much as shown on each half of Figs. 7, 8, and 9. Fig. 7 shows the appearance of a section through the middle of the subdivision *A*, Fig. 8 of one through the middle of the subdivision *B*, and Fig. 9 of one through the middle of the subdivision *C*. In these figures are brought into view not only the appearances in section of the root-fibres and nuclei of the nerves, but also of various important longitudinal and transverse tracts,—the superficial and deep transverse fibres of the pons, the pyramidal tract, the fillet, the peduncles, some of the most important of the cranial nuclei and root-fibres, and certain special nuclei and tracts, as the superior olive, the lateral nucleus, the dorsal longitudinal bundle, and the central tegmental tract.

The merest glance will show that in all positions the most important parts involved in lesions of the ventral and of the intermediate segments will be the superficial and deep transverse fibres and the pyramids. The fillet lies about the junction of the intermediate and dorsal segments, varying in its median and lateral positions in different cephalo-caudal sections. Nuclei and root-fibres are most prominent in dorsal segments.

The pyramidal tract dominates the symptomatology of ventrally situated pontile lesions, its destructive lesions, no matter where situated, giving certain uniform symptoms, and others which will vary somewhat according as the lesion is more cephalic than caudal, or the reverse. It is the great tract from the motor region of the cerebral cortex. In the mid-brain it gives off fibres which cross to the nuclei of the third and fourth nerves of the opposite side. In its course through the pons it sends fibres to the cell-nests of the motor fifth and of the abducens and facial nerves; but throughout its entire course, until the spinal cervical cord is reached, it contains the fasciculi for the arm and leg of the opposite side. Hence destructive lesions of this tract will always give paresis or paralysis of the opposite extremities. When the lesion is in the cephalic portion of the pons, before the decussation of the pyrami-

dal fibres for the trigeminal, abducens, and facial nerves, some ocular and especially some facial paresis may be present. This loss of power in the face must be distinguished from that caused by lesion of the facial root-fibres or nuclei. The paralysis of the face is central, and has features similar to that shown in the arm and leg. It is usually incomplete, although it may be more marked than when caused by a lesion situated higher in the pyramidal tract or in the cortex. It does not give the electrical reactions of peripheral facial paralysis.

Irritative lesions of the pyramidal tract in the pons and elsewhere may give rise to monospasm, or even to unilateral convulsions, chiefly affecting the limbs and face of the opposite side.

Often, in lesions of the ventral portion of the pons, the cranial nerves at, just before, or just after their superficial origins will be involved, giving various forms of so-called *alternate hemiplegia*. In lesion of the lower ventral third, or conjointly of the ventral and lateral thirds, the alternate hemiplegia will be of the arm and leg of the opposite side, and may be of the face on the same side; or facial, abducens, and auditory nerve paralysis of the same side may coexist with the paralysis of the extremities. In the middle ventral third, especially if the lesion extends laterally, paralysis of the leg and face

FIG. 7.

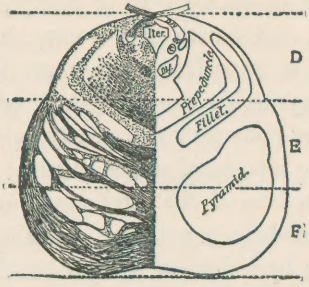



FIG. 8.

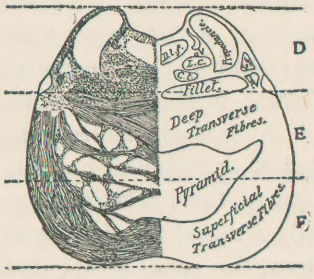
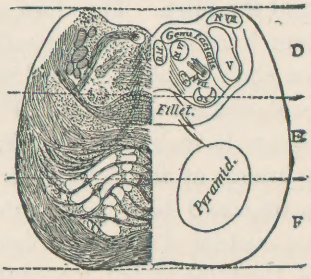



FIG 9.




Transections of the pons and preoblongata about the middle of each of the thirds A, B, and C, represented in the previous diagrams. The thirds D, E, and F correspond to the similarly designated thirds in Fig. 6. These figures show the relations and position of the most important structures: *O. S.*, superior olive; *C. t.*, central tegmental tract; *L. c.* and *c.*, locus ceruleus; *D. l. f.*, dorsal longitudinal fasciculus; *L. f.*, lateral fillet; *L. n.*, lateral nucleus; the numerals refer to nerve nuclei and roots.

of the opposite side may be associated with both motor and sensory paralysis in the distribution of the fifth nerve. In the cephalo-ventral segment the lesion may extend so as to implicate the third nerve, giving the oculo-motor type of alternate hemiplegia, or some paralysis of the third and fourth nerves may show on the same side.

The superficial transverse fibres of the pons which lie ventrally to the pyramids contain chiefly cerebellar fasciculi. In the middle third of the pons they run nearly horizontally, having a more oblique course in the lower and upper thirds. They connect special portions of opposite halves of the cerebellum, and also portions of the lateral lobes of the cerebellum with the opposite cerebral hemispheres. The symptoms given by lesions of special bundles of these superficial transverse fibres are not yet thoroughly known. I have reported a case in which, apparently as the result of a small hemorrhage involving these fibres, as well as some of the deeper parts of the pons, the patient had atrophy of one lateral lobe of the cerebellum and of the opposite hemicerebrum.

Passing to the intermediate segments, as seen in the transections Figs. 7, 8, 9, it will be seen that the pyramidal tract occupies part of this region, which also contains the *deep transverse fibres* and, near the junction of the intermediate and dorsal thirds, the fillet. A lesion centrally situated in the substance of the pons will, therefore, give symptoms the result of the destruction of these deep transverse fibres, and, if the lesion extends ventrally and dorsally, of both the pyramidal tract and the fillet. The deep transverse fibres constitute largely the structure known as the *trapezium* or *trapezoid body*, whose size and position show its physiological importance and the necessity of giving it a place in clinical diagnosis. Flechsig, Bechterew, Hans Held, Bruce, and others have shown that in it is the path of the cochlear nerve, which branch of the eighth pair is the true nerve of hearing. Fibres of the trapezoid body pass to the various auditory nuclei, and also to the roof nucleus of the cerebellum, and connect with the superior olives both of the same and of the opposite side. According to some authorities, the trapezoid fibres unite with the fillet, and according to others, they intersect it. While the lower or caudal border of the trapezium corresponds nearly to the same border of the pons, cephalad it only reaches as high as the place of emergence of the sensory root of the fifth nerve, and, therefore, it would be chiefly involved in lesions of the two lower thirds of the pons, as given in the diagrams.

The superior olive, which extends the whole length of the pons, is closely approximated to the dorsal surface of the trapezium, and is located, therefore, near the junction of the dorsal and intermediate

segments. Bechterew believed that the superior olive acted as a reflex centre for correlating the movements of the head and eyes with auditory impressions, and its lesions might therefore be expected to interfere with such correlations, causing a lack of response by the head and eyes to sounds coming from various directions. The connections of the superior olive which have been traced are with both accessory nuclei of the auditory nerve, with one or possibly both cerebellar roof nuclei, with the nucleus of the sixth nerve on the same side, with the dorsal longitudinal fasciculus of the opposite side, with the lateral columns of the cord, and with the postgeminum.

As the fillet, or at least its most mesal portion, is a part of the great sensory tract, its lesions cause disorders of sensation. Numerous cases have been reported in which deeply situated pontile lesions have given rise to anæsthesias, and especially to impairment or loss of the senses of pain and temperature; and numerous studies of degeneration following focal lesions have also shown the part played by the lemniscus as a sensory tract. The acoustic tract runs in the lower lateral division of the fillet to the postgeminum, so that lesions of the lateral fillet, like those of the trapezoid body, should give affections of hearing.

In the dorsal or preoblongatal portion of the region we are considering the structures are complicated. Here in various positions are the nuclei and root-fibres of the fourth, fifth, sixth, seventh, and eighth nerves; and, in addition, certain special fasciculi, as the dorso-longitudinal bundle and the central tegmental tract. Dorsal lesions in different fore-and-aft segments will, therefore, give varying forms of paralysis of the face; of trigeminal paralysis, motor and sensory; and of single or associated ocular palsies. As the third, fourth, and sixth are all nerves to the ocular muscles, and as in various movements of the eye these muscles act to a greater or less extent together, both on the same side and across the median line, the nuclei of these nerves must be anatomically connected, and lesions of their associating and correlating fibres will give special disorders of ocular movements. Some of the connections, it is believed, are by the dorsal longitudinal bundle.

Many of the curving strands in the pons and oblongatas run from the nuclei of the motor cranial nerves, partly to the opposite dorsal longitudinal bundle and partly to this fasciculus on the same side.

Bechterew, Edinger, and others have demonstrated a *central tegmental tract*, beginning near the dorsal accessory nucleus and passing cephalad in the mid-tegmentum. In one of my cases of thalamic disease with involvement of the superior limb of the internal capsule,

this tract with both inferior olives was found to be markedly degenerated, showing that it probably reaches to and even beyond the interbrain. According to Bechterew, it terminates in the lenticula. The position of this tract, according to Edinger, is shown in Fig. 9 (*C. t.*). This tract may serve to correlate the cell-nests of the sensory cranial nerves, as the dorsal longitudinal fasciculus does those of the motor.

Let me now enforce some of the points which I have endeavored to make with reference to segmental localization in the pons, by reference to recent and past clinical experiences in this hospital and elsewhere. Here are the photographs of Case I., one of the patients referred to at the beginning of the lecture (Figs. 10 and 11). He died a few weeks since. When he was brought before you the diagnosis was made of a lesion involving the abducens root-fibres and pyramidal tract in the pons.

This man had a history of syphilis. Eight or nine months before his death his left eye showed a tendency to turn inward, and for a time he saw double, and occasionally he had spells of vertigo. His left extremities were weaker than the right. He was extremely emotional, and often laughed or cried without motive or incitement. (See Fig. 11.) No anæsthesia was ever determined, but both legs seemed to be rather hyperæsthetic. Knee-jerks were exaggerated, especially on the left; muscle-jerks were also increased, and ankle clonus was present on both sides. The plantar reflexes were marked.

His vision was reduced to about one-half in the right eye and one-third in the left, but his fields could not be determined. The retinal arteries were small. Accommodation was good. The right external rectus muscle was paretic, the left was paralyzed, and ocular movements were restricted in accordance with these conditions.

I omit many details in this case unnecessary for our present purpose. The man, before death, developed gradually increasing mental and paralytic symptoms.

On autopsy, the lesion which chiefly concerns us in the present connection was found in the pons. A transection through the pons within the limits of subdivision *B* of our diagrams revealed a ventral lesion near the median line in the right half, which appeared to be limited, as shown in the drawing, Fig. 12. Subsequently, microscopical sections were cut and mounted by Dr. A. O. J. Kelly, from which drawings, shown in Figs. 13 and 14, were made by Dr. J. C. McConnell. These show that the area of softening and surrounding degeneration extended much farther than appeared in the fresh specimen. It reached to a considerable distance on both sides of the

FIG. 10

FIG. 11.

Case of pontile lesion (Case II.): Fig. 10 shows paralysis of the external rectus and expression of the face at rest; Fig. 11 shows the patient's expression at the time of uncontrollable emotional disturbance.

median line, as shown in both drawings by the lighter areas. The destruction and degeneration involved both pyramidal tracts, the deep transverse fibres, and to a less extent the superficial transverse fibres. The root-fibres of the right abducens, and to a large degree those of the left, were also probably implicated. The destruction was much greater on the right than on the left side, causing a large shrinkage in general bulk on the right. The paralysis and paresis of the extremities were due to the involvement of the pyramidal tracts. Implication of the abducens root-fibres caused the ocular paralysis of one side and the paresis of the other.

FIG. 12.

Drawing showing the position and apparent size of the pontile lesion in the fresh specimen from Case I. in the text, and illustrated in Figs. 10 and 11.

CASE II.—Last year a case of pontile lesion was shown to the class, and reported at the meeting of the American Neurological Association by Dr. John Zimmer and myself. The day before admission to the hospital the patient was attacked with vertigo, double vision, and paresis of the right arm and leg. She had imperfect articulation; at rest the right eye turned strongly to the right, while the left was not deviated; both eyes could not be turned together to the left; the lateral movement of the left

FIG. 13.

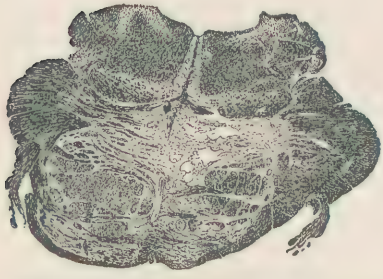
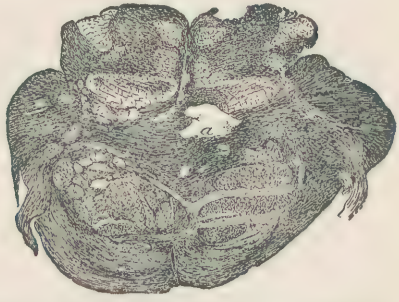


FIG. 14.



In Figs. 13 and 14 are shown the microscopical appearances of the lesion in Fig. 12. The degeneration is seen to extend across the median line and over a large area.

eye to the right was also impaired, and slight nystagmus of both eyes was present. The lids of the left eye could not be fully brought together. Right facial paresis was present. Tendon and muscle phe-

nomena were much exaggerated in the paretic limbs. No anæsthesia was discovered As determined at the autopsy, the pontile lesion was a circumscribed softening with hemorrhagic infiltration, reaching at its cephalic extremity nearly to the ventral surface of the pons, more caudally extending towards the raphe, and about the middle of the pons slightly crossing the mesial line. The area of softening

Fig. 15.

Fig. 16.

Fig. 17.

Figs. 15, 16, and 17 show the position of the pontile lesion in Case II., described in the text, the sections being through *A*, *B*, and *C* of Fig. 18.

Fig. 18.

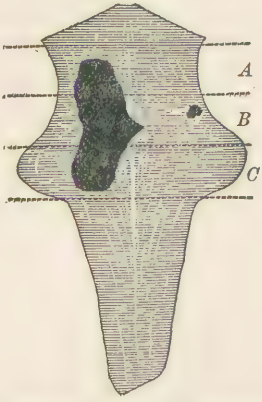
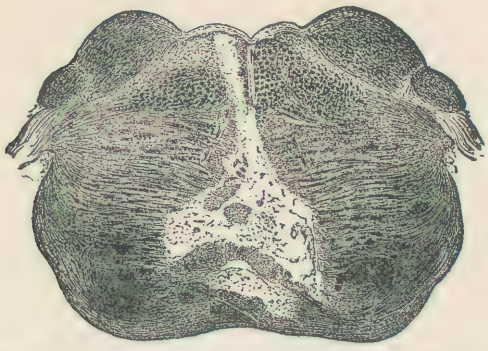



Diagram showing the antero-posterior dimensions of the pontile lesion in Case II.

became smaller and more deeply situated as it approached the post-oblongata, which it almost, but not quite, reached. Drawings were made by Dr. Zimmer of the appearances presented at the time of the autopsy, and Figs. 15, 16, and 17 give a good idea of the position and apparent extent of the lesion as then noted. Fig. 18 shows that the longitudinal extent of the lesion was such as to involve, on the left side of the pons, all three of our subdivisions *A*, *B*, and *C*. The three transections from which the other figures are drawn would have fallen respectively within our subdivisions *A*, *B*, and *C*, but not exactly in the planes represented by the transections of normal structures (Figs. 7, 8, and 9). It was found on microscopical investigation that the area of destruction and degeneration extended for a considerable distance beyond the lesion as it appeared in the fresh state, reaching both across the median line and in other directions, as shown in a drawing by Dr. J. C. McConnell (Fig. 19). At one

position close to the median line it reached almost to the floor of the ventricle.

Fig. 19.



Microscopical appearance of a transection through the lesion in Case II.; the section was made through the middle third of the lesion in about the position shown in Fig. 16.

Years ago I published the account of a case of tumor of the pons, in which the chief symptoms of focal lesion were hemiparesis, partial right ptosis, diminished sensation on the left side of the face and right limbs, conjugate deviation of the eyes and rotation of the head to the right, persistent epistaxis, and a tendency to hemorrhage from the mucous membranes. The autopsy revealed a gumma about half an inch in diameter, distinctly limited to the left cephalic quarter of the pons.

Another case of central softening of the pons has also been reported by me. None of the cranial nerves were superficially involved, although the lesion was unusually large. The clinical history showed headache, a vertiginous seizure followed by partial right hemiplegia, left convergent strabismus, defective articulation, and paralysis of the left arm three weeks after the attack; another seizure, accompanied by great emotionality, profuse perspiration, difficulty in breathing and swallowing, inability to speak and to thrust out the tongue or open the mouth wide, and paralysis of both arms and legs; and at the last conjugate deviation to the right.

Conjugate deviation of the eyes and head is a not infrequent accompaniment of lesions, and especially of tumors towards the cephalic extremity of the pons. Vaso-motor phenomena, such as pallors, flushings, and the epistaxis and mucous hemorrhages referred to above, may be present in pontile lesions, as may also special temperature changes. These are probably due to implication of vaso-motor and heat centres; but time will not permit the discussion of the entire subject of pontile lesions in this lecture.

Thus far in the cases to which I have called your attention the diagnoses have been confirmed by autopsies. Recently a patient of peculiar interest in connection with my lecture was admitted to the men's nervous wards,—an excellent example of conjoint trigeminal and facial paralysis, with some impairment of hearing. He is a young man of about twenty-six years of age, with a history of syphilis. About two weeks before admission he observed that the right side of his face was paralyzed and insensitive. When admitted, examination showed complete paralysis of the right facial or seventh nerve, also of the muscles supplied by the motor division of the fifth nerve. The patient was also anæsthetic on the right side of the face, including the conjunctiva and cornea. The hearing, as determined by the watch, was good on the left side, but on the right it was necessary to bring the watch close against the ear before its tick could be heard. He had, however, no tinnitus. Taste was lost on the right side both on the anterior and posterior portions of the tongue. He had neither paralysis nor anæsthesia of any part of the body below the neck. The symptoms in this case are probably due to a lesion of the lateral aspect of the pons, although they might be explained by a lesion within the substance of the pons and preoblongata, so situated as to injure or destroy the sensory and motor root-fibres of the fifth, the facial and glossopharyngeal root-fibres, and some of the acoustic root-fibres, or perhaps fibres of the auditory tract in the trapezoid body or lateral fillet. The electrical reactions in the muscles of the face were those of peripheral paralysis.